THURSDAY, APRIL 19, 1906.

THE GLOSSOPTERIS FLORA.

Catalogue of the Fossil Plants of the Glossopteris Flora in the Department of Geology, British Museum (Natural History); being a Monograph of the Permo-Carboniferous Flora of India and the Southern Hemisphere. Pp. lxxiv+255. By E. A. Newell Arber, (London: The British Museum [Natural History]. Published by Order of the Trustees, 1905.) Price 12*s.* 6*d.*

IN this catalogue the author makes "an attempt towards a complete summary of what is at present known on the subject of the Glossopteris Flora," and he may be cordially congratulated on the successful completion of a task both arduous and difficult. Dr. Smith Woodward, the keeper of the department of geology, has very wisely encouraged the production of catalogues, which are in reality monographs of the greatest value to both botanical and geological students. The scattered literature dealing with the Glossopteris flora renders the work of the monographer very heavy, and the nature of much of the material on which he must base his conclusions necessitates considerable self-control and caution.

Mr. Arber's introduction treats of the Glossopteris flora under three heads:—(1) its botanical affinities; (2) its distribution in space; (3) the evidence as to its age and distribution in time. The sediments of Upper Carboniferous and Permian age have yielded a rich supply of fossil plants in both hemispheres; but in the case of India, Australia, South Africa, and South America the difficulty of drawing a satisfactory line between the Carboniferous and Permian strata has forced geologists to adopt the term Permo-Carboniferous for the plant-bearing beds of India and more southern lands. In these Permo-Carboniferous strata the genus Glossopteris is the most abundant fossil, and for this reason the southern vegetation which flourished during the epoch between the Lower Carboniferous and Triassic periods has been designated the Glossopteris flora. It has long been recognised that the Glossopteris flora differs in too many respects from the northern flora of the same geological age to justify the belief, which was formerly held, as to the world-wide distribution in the latter part of the Palæozoic era of the vegetation which is represented by the rich stores of fossils in the American and European Coal-measures. The approximate distribution of the plants of the two provinces is clearly shown in the maps published by Mr. Arber (p. xix.).

One very serious difficulty in the way of giving a satisfactory botanical account of the Glossopteris flora is the lack of petrified material, and, in the case of nearly all the genera, the absence of fertile leaves or shoots. The genus Calamites, represented by several distinct types in the northern flora, has not so far been recognised in the Glossopteris flora; in its place occur Phyllotheca and Schizoneura, two representatives of the Equisetales about which our information is still very incomplete. Both genera are adequately treated by Mr. Arber, but the botanist, however thorough the treatment, cannot help being made aware of the insufficiency of the material at his disposal. The genus Sphenophyllum affords another example of a characteristic northern type which can hardly be considered a true member of the Glossopteris flora. It is true, as Mr. Arber points out, that Prof. Zeiller has shown good reason for referring the Indian specimens, for which Royle in 1833 instituted the genus Trizygia, to Sphenophyllum. Mr. Arber figures a fragment from Natal as Sphenophyllum sp., but the specimen is too imperfect to serve as satisfactory evidence of the existence of the genus in South Africa. In the case of plants with fern-like fronds we cannot speak with any confidence as to their botanical position.

The simple tongue-shaped leaves with a distinct mid-rib and anastomosing secondary veins, which Brongniart named Glossopteris and placed among the ferns, have never been found, in spite of their extraordinary abundance, with sori or sporangia. A recent discovery by Mr. Arber affords the first satisfactory clue to the nature of the sporophylls. The fronds of Glossopteris are occasionally found in association with smaller scale-leaves, and on these groups of sporangium-like organs have been detected. These bodies are considered, on the whole, to exhibit a greater resemblance to the microspores of recent cycads than to the sporangia of ferns. The palæobotanist who describes specimens of Glossopteris is compelled to face the problem of recognising specific characters among the numerous leaf-forms, but if he knows anything of recent ferns he must admit that he has undertaken an impossible task. Mr. Arber, with the conscientious care which characterises his work, has grappled with this difficulty, and his synopsis of species supplies us with the best working scheme so far devised.

Neuropteridium is another southern genus founded on simply pinnate and sterile fronds, which, like Glossopteris and Gangamopteris, must be left as a plant of doubtful position. Among other members of the Glossopteris flora which it has been customary to place among the ferns are Tæniopteris, Sphenopteris, and Pecopteris; but the absence of fertile fronds again sets a limit to our knowledge. One interesting conclusion to be gleaned from the occurrence of certain ferns in the southern Permo-Carboniferous vegetation (*e.g.* Tæniopteris and Cladophlebis) is that the Glossopteris flora includes types which, in the northern hemisphere, are rather Mesozoic than Palæozoic.

Schizoneura, Neuropteridium, and Voltzia (a conifer) also represent other genera which apparently migrated into Europe in early Mesozoic times. Another striking fact is the absence of any members of the lycopodiales in the Glossopteris flora of Australia and India. On the other hand, Lepidodendron, Sigillaria, and some rather obscure specimens referred to Bothrodendron have been found in South Africa and South America. Mr. Arber takes the view that the occurrence of these fossils in South America and South Africa may be accounted for by

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migration from the northern flora. It must, however, be borne in mind that lycopodiaceous plants existed in the far south in the Lower Carboniferous epoch.

Another characteristic member of the northern flora, which is not included in lists of plants from Gondwana Land (the name given by Suess to the southern continent which supported the Glossopteris flora), is Cordaites. It is, however, probable that the strap-like linear leaves known as Nœggerathiopsis, which are abundant in the southern Palæozoic province, are in some cases at least generically identical with Cordaites. This opinion, previously expressed by the reviewer, was strengthened by an inspection of some leaves recently discovered by Mr. Leslie which he had an opportunity of seeing last summer at Vereeniging. We have as yet no satisfactory evidence that the Cycadophyta were represented in the true Glossopteris flora. Similarly, we cannot assert with confidence that the few specimens compared by various writers with the existing *Ginkgo biloba* afford any proof of the existence of the ginkgoales. The coniferales did not play a conspicuous part in the southern vegetation; various fragments have been referred to Voltzia and other genera, but such specimens as occur appear to be indistinguishable from northern Triassic and Rhætic forms.

Although recent work has perhaps tended to bring more closely together the northern and southern Permo-Carboniferous floras, there can be no doubt as to the correctness of the view that the later Palæozoic vegetation of India, South America, South Africa, and Australia differed sufficiently from that of the northern hemisphere to justify the recognition of two botanical provinces. The southern flora lacks the richness and variety which characterise the northern; the number of genera is smaller, and in many localities the abundance of Glossopteris—almost to the exclusion of other genera—suggests a greater monotony in the vegetation. To some extent the apparently greater wealth of the northern flora may be the result of exceptionally favourable conditions for the preservation of land plants, but this does not account for the strikingly different facies. The existence of widespread Glacial deposits in India, South Africa, and Australia furnishes us with a probable means of explaining the uniformity in the vegetation of Gondwana Land and the contrast which it presents to that of the northern hemisphere. In the case of many European genera we are able to make use of anatomical characters as an index of conditions of growth, but the almost complete absence of petrified specimens in the southern province compels the admission that we cannot claim to recognise in the plants themselves any satisfactory evidence as to the nature of the climate in which they grew.

We can cordially recommend Mr. Arber's volume as the best and most comprehensive account of the Glossopteris flora which has been written; he has produced a book bearing the impress of wide knowledge and of a well balanced critical faculty, which cannot fail to be of the greatest value to both geologists and botanists.

A. C. Seward.

A GROUP OF TEXT-BOOKS OF PHYSICS.

(1) *The Organised Science Series:* (1) *First Stage Physiography* (*Section I.*). Edited by Dr. R. W. Stewart. Pp. xiii+256; diagrams. (London: University Tutorial Press, Ltd., 1905.) Price 2*s.*

(2) *Science Handbooks for Laboratory and Classroom: Elementary Physics* (*Third Year*). By John N. Brown. Pp. 111+diagrams. (London: Blackie and Son, Ltd., 1905.) Price 2*s.*

(3) *Examples in Physics.* By C. E. Jackson. Pp. vi+172. (London: Methuen and Co., n.d.) Price 2*s.* 6*d.*

(4) *Advanced Examples in Physics.* By A. O. Allen. Pp. 60. (London: Edward Arnold, n.d.) Price 1*s.* 6*d.*

(5) *Physics.* By Charles R. Mann and George R. Twiss. Pp. x+453; illustrated. (Chicago: Scott, Foresman and Co., 1905.) Price 1.25 dollars.

THE stream of physics text-books continues to flow. The large number of institutions in which this subject is now taught probably makes inevitable a corresponding multiplicity in the text-books issued. Each teacher or group of teachers finds something lacking in the books available for his classes, and at the first opportunity a new manual is produced. But besides the stimulus of this thoroughly healthy quest of the ideal, the requirements of examination syllabuses are important factors in giving rise to publication. Each examination has its independent syllabus somewhat arbitrarily selected from the suggestions of the members of a board, meeting in committee, and the result is that every examination is thought to require a special text-book by those who wish to secure a maximum of passes for their pupils at the least expenditure of labour.

(1) Although the latter motive is distinctly present in connection with the first of the books in our list, we must at the same time readily admit that it is a most admirable volume except in name. It is a mystery why one part of chemistry added to two parts of physics should produce "physiography," but of course Dr. Stewart is not responsible for this. The book has been written to meet the requirements of the Board of Education in regard to the examination bearing its name. Dr. Stewart is no novice in the writing of text-books. He is alive to the difficulties which pupils encounter, and he removes them in advance. The outcome is a manual which rises far above the particular purpose for which it was written, and it may be confidently recommended as a very satisfactory introduction to physics and chemistry suitable for school use. It contains a large number of examples, many of which are worked out.

(2) Mr. Brown's handbook on elementary physics forms one of a series issued under the general editorship of Dr. J. G. Kerr. It is intended as a third year's school course, practical and theoretical. The matter is to some extent of the same kind as the physical part of Dr. Stewart's text-book; we cannot, however, bestow the same praise upon it. The theoretical part is very meagre, and, moreover, in

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